REMARKS

Summary of Amendments

Claims 1-14 have been canceled as being drawn to a non-elected invention, and claim 19 has been amended to correct an editorial error. Claims 15-24 thus remain pending.

Election/Restriction

Although Applicants' March 22, 2006 reply to the restriction requirement was made with traverse, Applicants do not intend to take action under 37 C.F.R. § 1.144, and thus have fully acquiesced to the requirement.

Claim Rejections - 35 U.S.C. § 112

Claim 19 was rejected for reciting "gas flow means" despite all other occurrences of this phrase having been amended to "gas flow controller." This editorial mistake has been corrected by the present amendment.

Rejections – 35 U.S.C. § 103

Claims 15-24; Ishii '942 in view of Kumihashi et al. '685

Claims 15-24 stand rejected as being unpatentable under 35 U.S.C. § 103(a) over U.S. Pat. No. 5,685,942 to Ishii, in view of newly cited U.S. Pat. No. 5,368,685 to Kumihashi et al.

The outstanding § 103 rejections of claims 15-24 repeat the content of the § 103 rejections of independent claims 15, 19, 22, and 24 made in the first Office action on the merits, insofar as the outstanding rejections list the basic elements recited in the independent claims, and ascribe a correlation of those elements to corresponding elements in the '942 patent to Ishii.

In making the § 103 rejections this time, however, the Office acknowledges that *Ishii* does not teach certain key features of the present invention, now recited in claims 15, 19, 22, and 24 as:

the gas-flow controller being configured to

> control said mass-flow controllers so that said gas-supply unit delivers the etching gas into said etching chamber at an intermittent flow obeying a predetermined rectangular waveform varying between zero and a

predetermined value, and delivers the protective-film-forming gas into said etching chamber at a continuous flow (claim 15), and

control said mass-flow controllers so that said gas-supply unit delivers the etching gas into said etching chamber at a volume-variant flow obeying a first predetermined rectangular waveform, and delivers the protective-film-forming gas into said etching chamber at a volume-variant flow obeying a second predetermined rectangular waveform whose phase is the inverse of that of said first predetermined rectangular waveform (claim 19);

the base-power controller being configured to

control said second RF power supply to vary periodically the power said second RF power supply applies to said base (claim 22); and

the coil-power controller configured to

control said first RF power supply to vary periodically the power said first RF power supply applies to said coil in said plasma generating unit (claim 24).

In particular, after acknowledging that *Ishii* fails to teach the above-recited key features of the present invention, the Office cites Kumihashi '685 to make the general assertion that *Kumihashi* teaches "process-control cyclic algorithms for process-gas injection and RF application." This general assertion is then extended by the Office to comment that "optimizing" the (gas-flow/RF-coil-power) controller of *Ishii* according to the algorithms of *Kumihashi* would "improve[e] throughput during processing as taught by *Kumihashi*."

It is respectfully pointed out, however, that the Office does not state, let alone demonstrate, that combining the teachings and disclosures of the Ishii and Kumihashi references would lead to the present invention—rather, the Office only notes that the teachings of *Kumihashi* could improve the apparatus taught by *Ishii*. Yet the Office does not specifically detail how such an improved Ishii apparatus would render the present invention obvious.

Although *Kumihashi* may be said, as the Office states, to teach process-gas injection and RF application algorithms, they are not the process-gas injection and RF-application algorithms of the present invention. Therefore, a gas-flow/RF-coil-power controller configured to carry out the *Kumihashi* algorithms would have a different configuration from a gas-flow/RF-coil-power controller configured to carry out the features of the present invention as recited in claims 15-24, at least for the flowing reasons.

Kumihashi is directed to increasing selectivity ratios in etching, which entails improving anisotropy. *Kumihashi* achieves this goal by controlling the rates at which the etching/deposition gases are exchanged—in particular by switching the supplying of the gases with a rapidity such that the etching proceeds in increments on the order of the size of the atoms constituting the substrate being etched. (Cf. Embodiment 5 of *Kumihashi* in particular.) Such high-speed switching necessitates shortened gas "residence" time, meaning that a given gas must be nearly totally evacuated from the reaction chamber that much more rapidly. *Kumihashi* is also concerned with boosting the applied RF power to provide the higher plasma density required as a consequence of the increased gas-supply switching rates.

The issue as to whether *Kumihashi* in combination with *Ishii* renders the present invention obvious centers on whether *Kumihashi* can be said to disclose, teach, or suggest a gas-flow controller configured to deliver into the reaction chamber etching gas at a variable flow and deposition gas at a continuous flow, and base-power and coil-power controllers configured to vary periodically the power that the RF power supplies apply to the substrate-carrying base and to the plasma-generating unit coil.

According to the present invention, continuously flowing the deposition gas and variably flowing the etching gas means that the deposition gas is flowed simultaneously with the etching gas. *Kumihashi* nowhere discloses, teaches, or suggests deposition gas is flowed simultaneously with the etching gas; on the contrary, *Kumihashi* is concerned with exhausting the etching/deposition gases to the 95% minimum evacuation necessary to maintain the desired supply-switching speed while avoiding any mixing of gases such as would deteriorate throughput. (Cf. column 7, lines 25-37, for example.)

Thus, *Kumihashi*, in teaching minimization of etching/deposition gas residence time, actually teaches away from the present invention. In accordance with the present invention, in contrast to the *Kumihashi* teachings, the deposition gas is always "in residence" within the reaction chamber.

Kumihashi may achieve improved anisotropy, but as necessarily attendant on speeding up process times to improve selectively ratios. The present invention achieves improved anisotropy, but by carrying out gas-flow/RF-coil-power control functions that are utterly different from anything disclosed, taught, or even suggested in *Kumihashi*, because the control functions of the present invention are based on a completely different approach from that taken by *Kumihashi*.

Furthermore, *Kumihashi* teaches no control of the *Kumihashi* etching-apparatus' RF power that could be said to render obvious the base-power controller of the present invention. *Kumihashi's* RF power source 16 is merely described as being for connection "with the sample stage 11 so that an RF bias can be applied to the wafer 14" (column 10, lines 10-12). The only other mention of the sample-stage 11 power

source 16 is in column 12, lines 53-54, which state, "An RF power source 16 can apply an RF bias at 400 kHz to 13.56 MHz."

Thus, *Kumihashi* is utterly conventional as regards the application of RF power to the substrate-carrying sample stage. Nowhere does disclose, teach or suggest a base-power controller configured, as recited in claim 22, to vary periodically the power that the RF power supply applies to the substrate-carrying base.

Lastly, *Kumihashi* teaches no control of the plasma-generating coil ("solenoid coils 24") that could be said to render obvious the coil-power controller of the present invention. The solenoid coils 24 are introduced in column 9, lines 33-36, as carrying out the conventional function of generating a magnetic field so that "the microwave energy [produced] is effectively absorbed in the plasma." And an analogous description of the solenoid coils 24 is made under Embodiment 4, in column 12, lines 36-40.

The only other mention of the solenoid coils 24 is in column 10, lines 57-63, which state

> The exterior magnetic field condition can be regulated by regulating the current which is caused to flow through a solenoid coil 24 (Fig. 1) and the position of the coil. By means of the above regulating means and method, the uniformity of the ion current density can be improved, which leads to etching with improved uniformity.

Thus regulating the current flowing through the solenoid coil 24 is toward ensuring uniformity of the ion-current density that, as noted above, provides the higher plasma density necessitated by the increased gas-supply switching rates utilized in an etching apparatus according to *Kumihashi*. Nowhere does disclose, teach or suggest a coil-power controller configured, as recited in claim 24, to vary periodically the power that the RF power supply applies to the plasma-generating unit coil.

For the foregoing reasons, then, it is respectfully submitted that independent claims 19, 22 and 24 are non-obvious, and therefore patentable, over the prior art of record. Moreover, inasmuch as claims 16-18, 20 and 21 depend from claims that for the foregoing reasons it is respectfully asserted should be held allowable, these claims should be also held allowable as depending from allowable parent claims.

Accordingly, Applicants courteously urge that this application is in condition for allowance. Reconsideration and withdrawal of the rejections is requested. Favorable action by the Examiner at an early date is solicited.

Respectfully submitted,

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/James Judge/

James W. Judge
Registration No. 42,701

JUDGE & MURAKAMI IP ASSOCIATES
Dojima Building, 7th Floor
6-8 Nishitemma 2-Chome, Kita-ku
Osaka-shi 530-0047
JAPAN

Telephone: **305-938-7119**
Voicemail/Fax: **703-997-4565**